
DARPA
DARPATech
2002 Symposium
Transforming
Fantasy

DARPA

Steven G. Wax

Deputy Director,
Defense Sciences Office

Transforming Fantasy

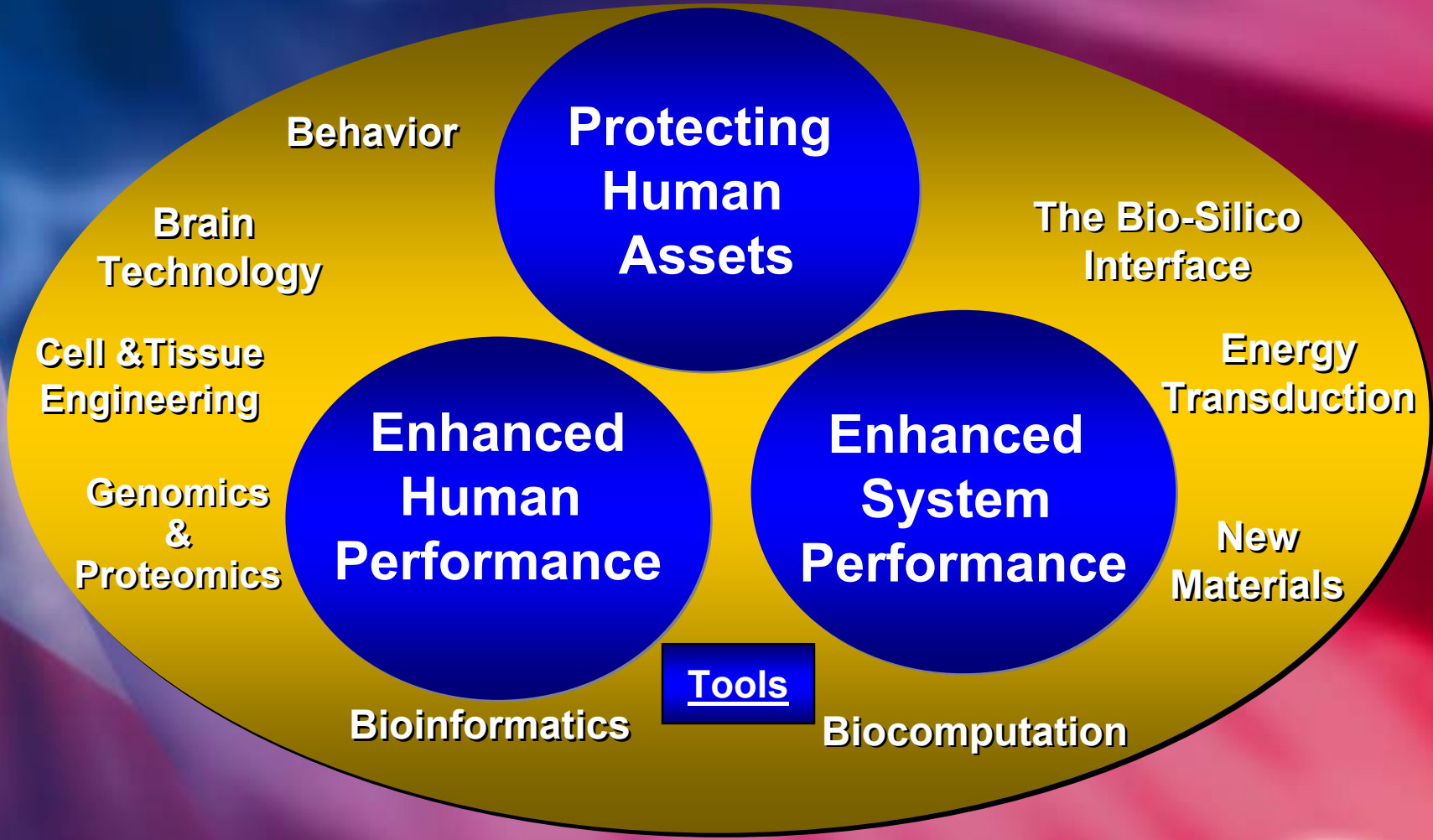
Enhancing System Performance

Exploiting Nature Through Materials and Design

Transforming Fantasy

DARPA

Biology…
DARPA's Future Historical Strength

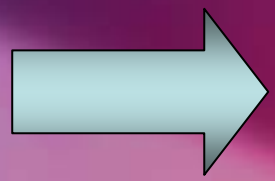


Transformative Fantasy

DARPA

Characteristics of Biology

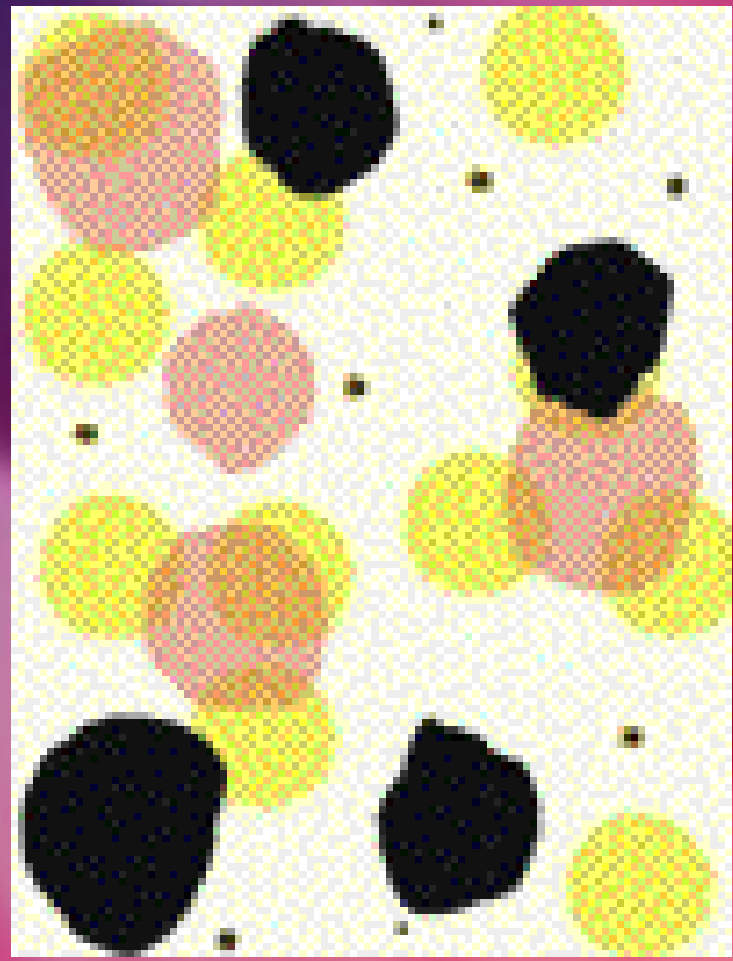
- Self-Propelling
- Self-Fueling
- Self-Protecting
- Self-Healing
- Fault-Tolerant
- Dynamically Adaptive
- ***Self-Replicating***

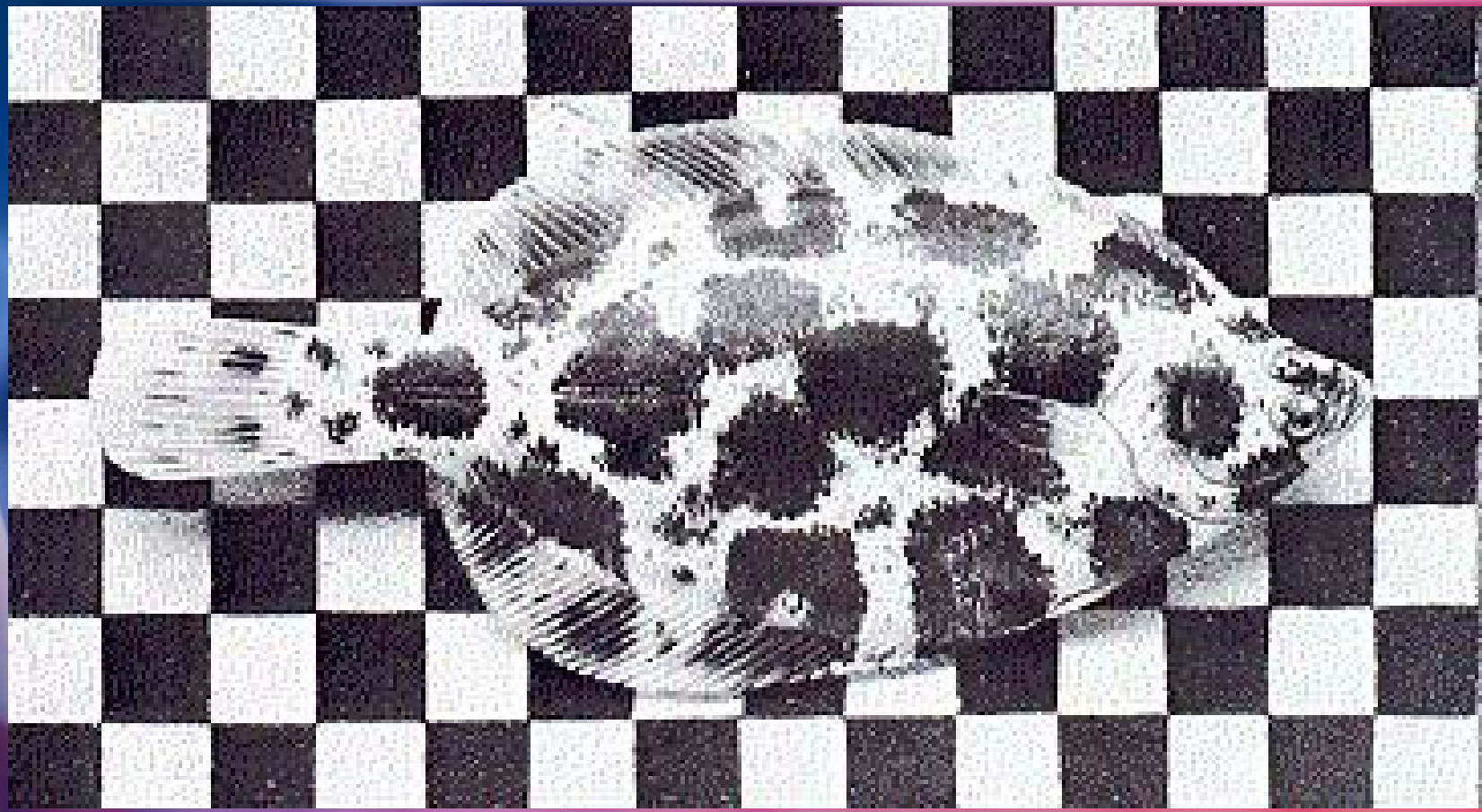


Autonomous

Cephalopod Camouflage

www.cephbase.utmb.edu

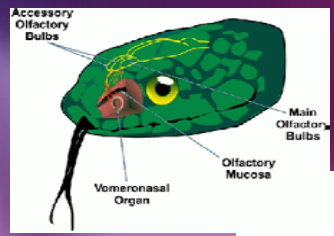




Bio-Inspiration to Biomimetic

INSPIRATION

Observe – Minimal Use of Biological Principles and Materials



Copy – Exploit Biological Principles and Materials

MIMICRY

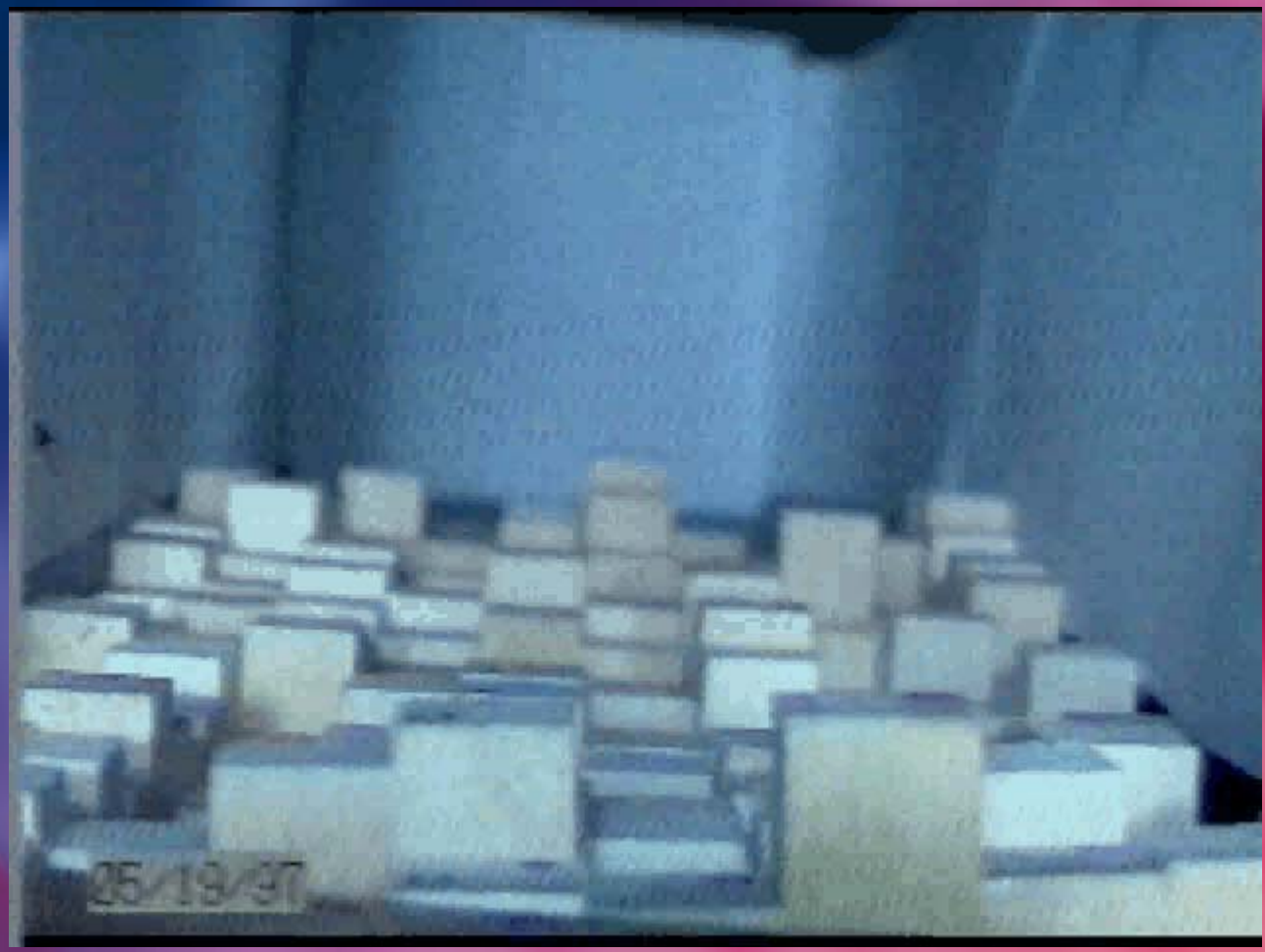
"Nature's pool of ideas is only valuable if it can be translated into terms that the technologist can work with, particularly in terms of materials and processing methods."

Phillip Ball, *Nature*, January 18, 2001

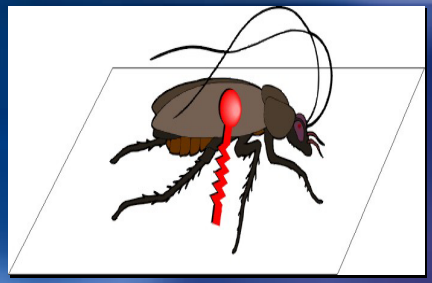
The Challenge

Natural	Man-made
Small	Large
Curved	Flat, rt angles
Bends, twists	Stiff

Cockroach Model



Why Legs Matter



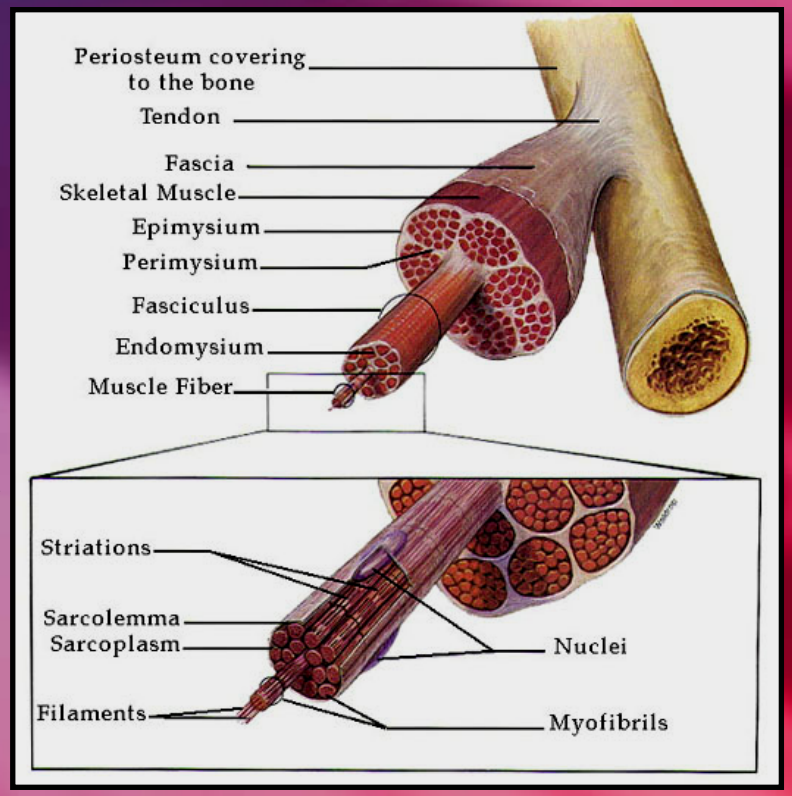
Natural Muscle is:

- An Actuator
- A Sensor
- A Structural Material
- A Spring and Damper
- Soft, Compliant

M.H. Dickinson, et al. Science 288, 100-106(2000)

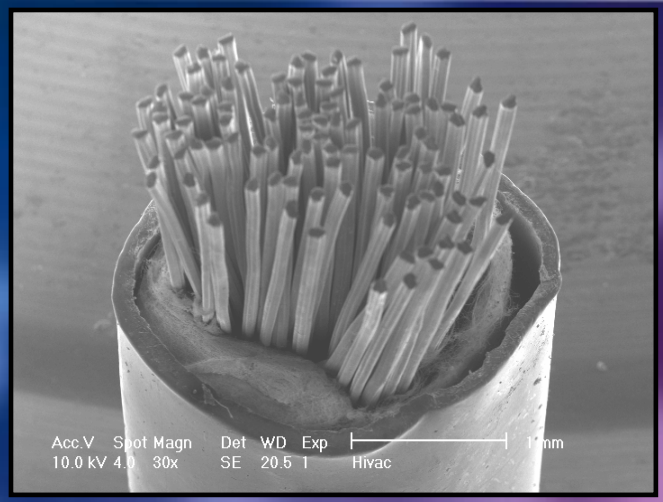
Natural Muscle is:

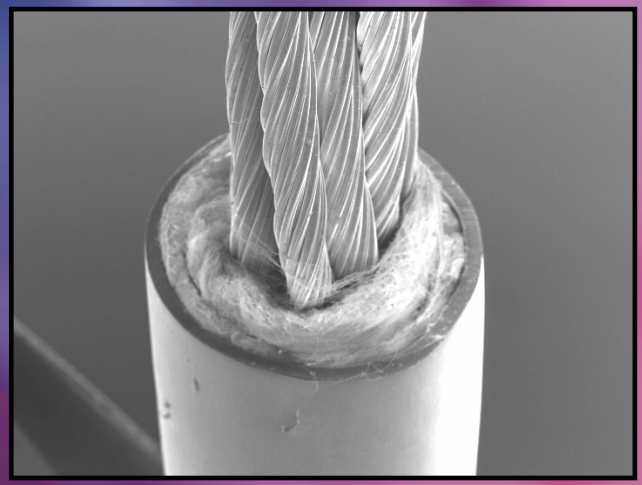
- An Actuator
- A Sensor
- A Structural Material
- A Spring and Damper
- Soft, Compliant

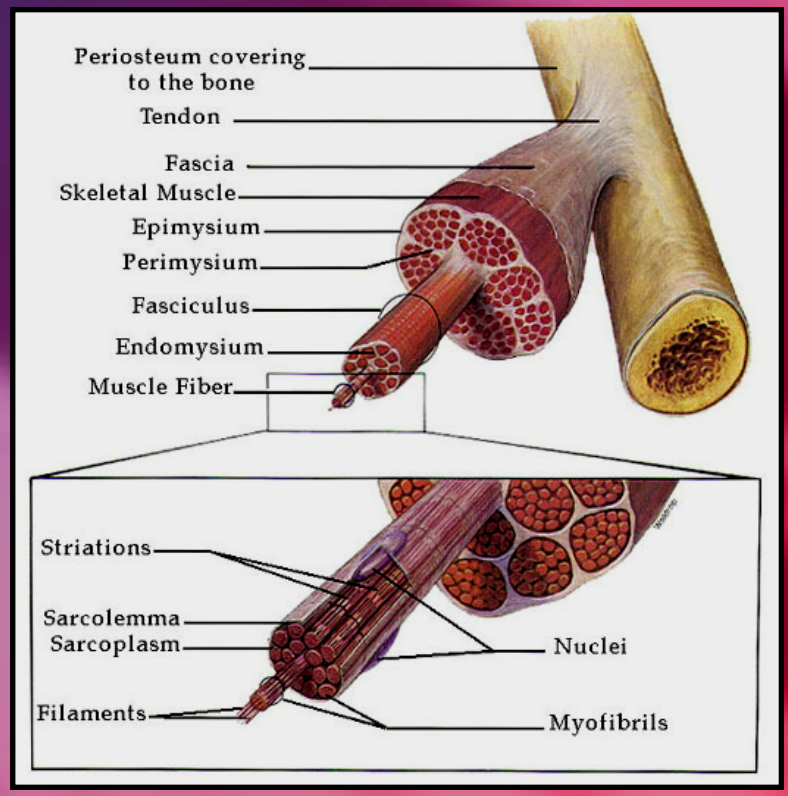


M.H. Dickinson, et al. Science 288, 100-106(2000)

Artificial Muscle



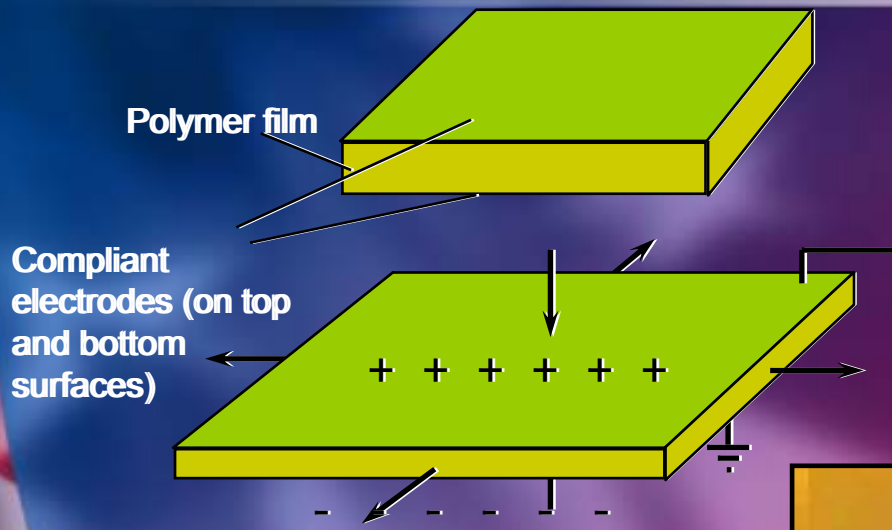


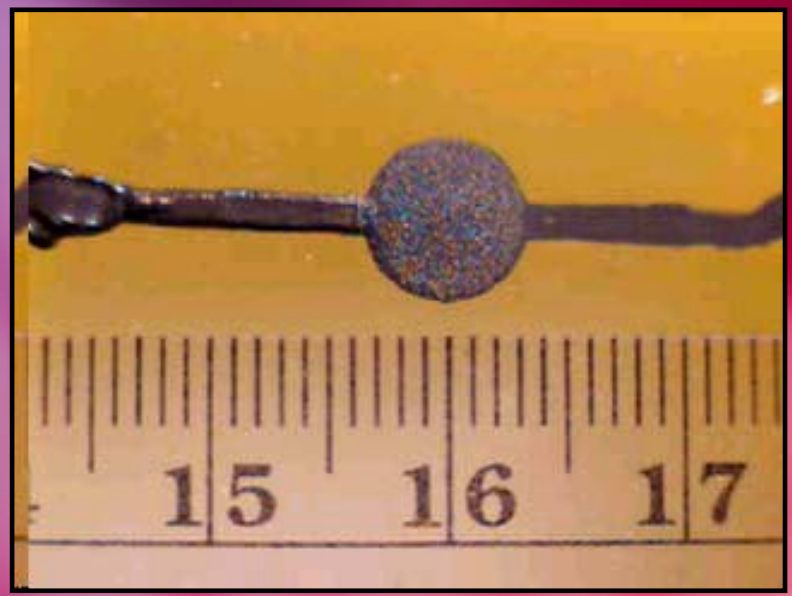


Transforming Fantasy

DARPA

Artificial Muscle

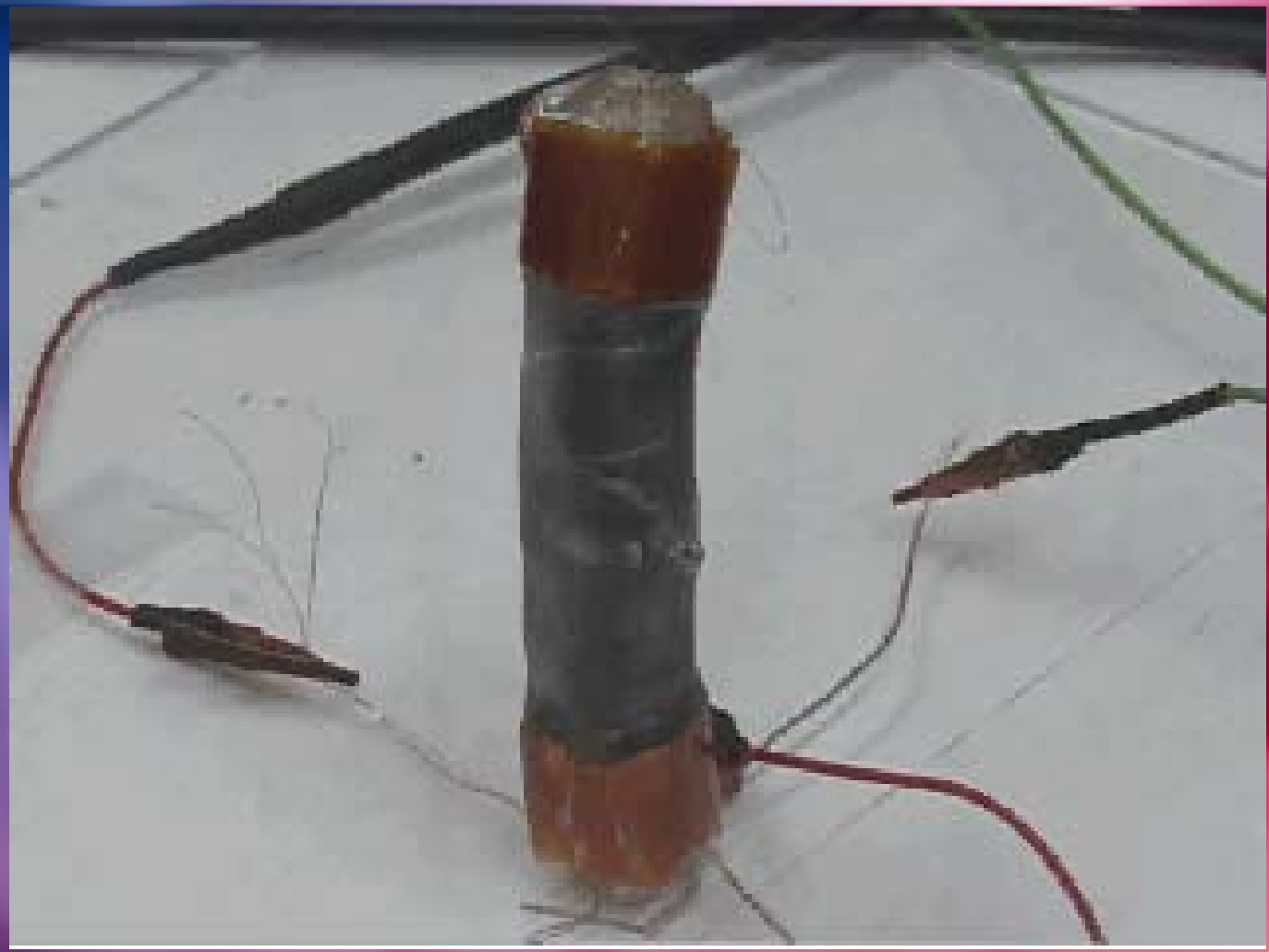




Transforming Fantasy

DARPA

Artificial Muscle



Artificial Muscles Walking

Transforming Fantasy

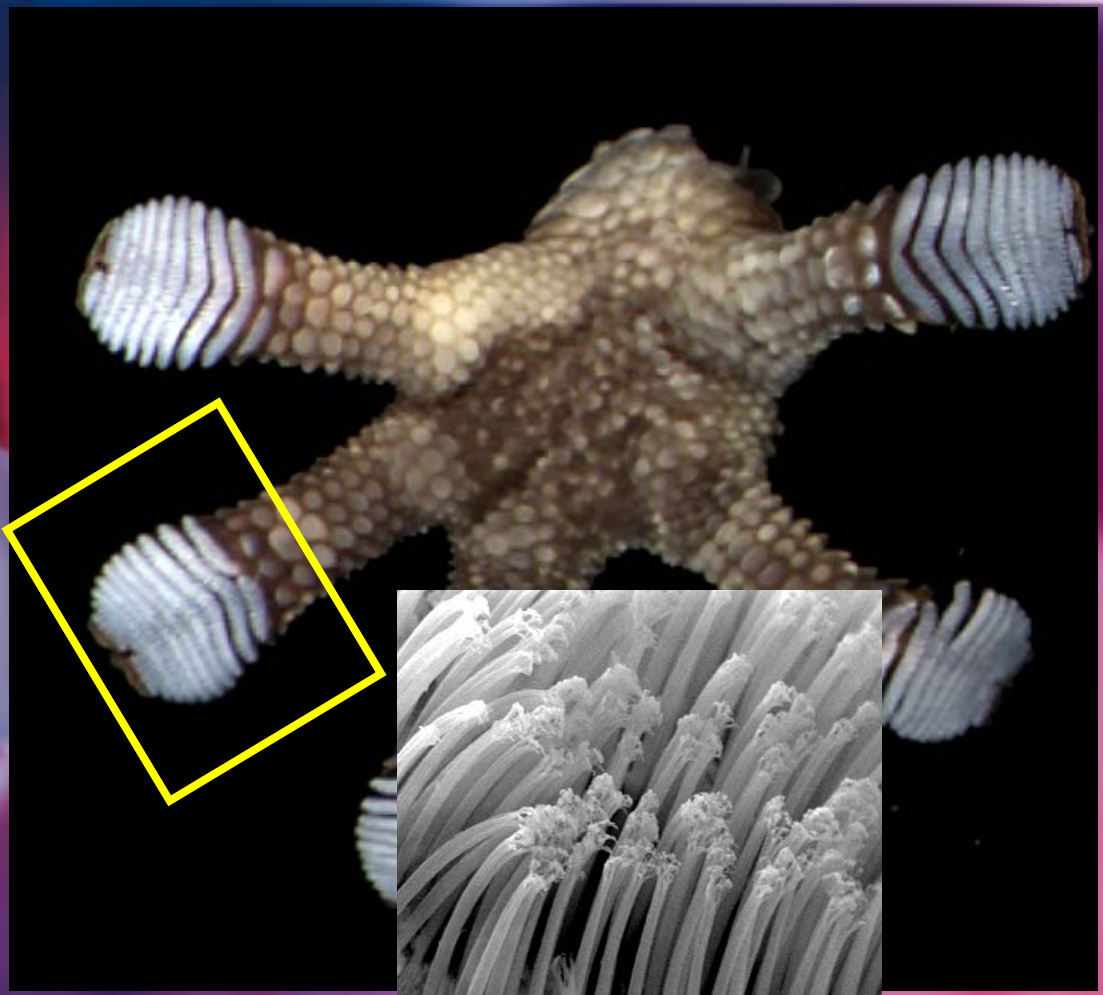
DARPA

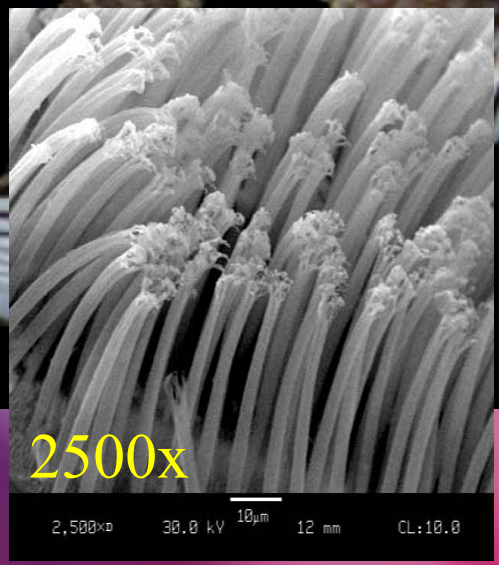
Transformative Fantasy

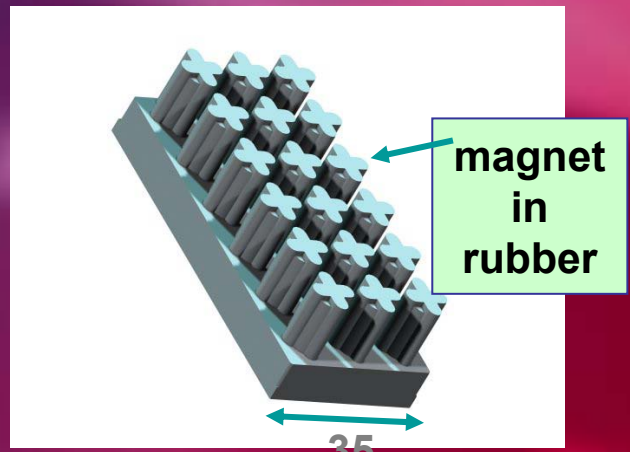
DARPA

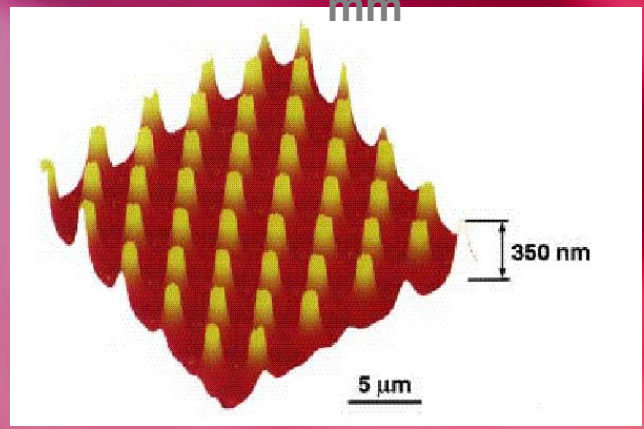
Amazing Feet

Amazing Feet

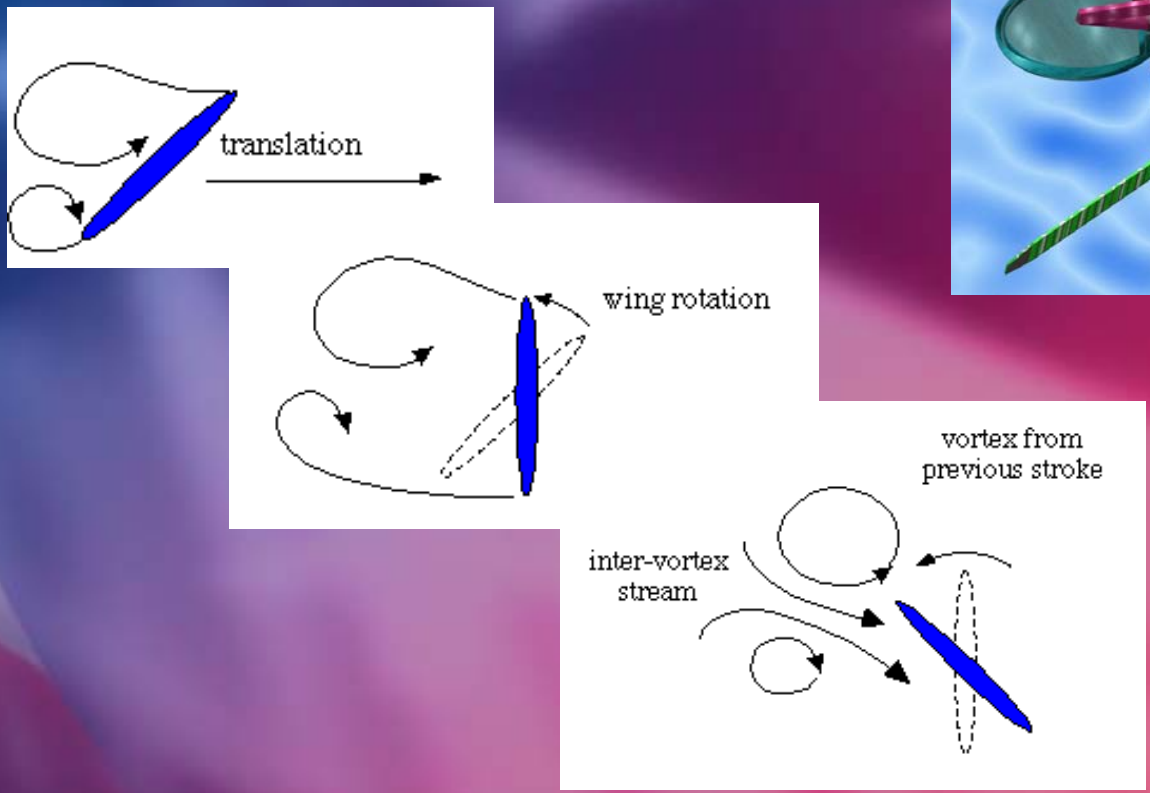


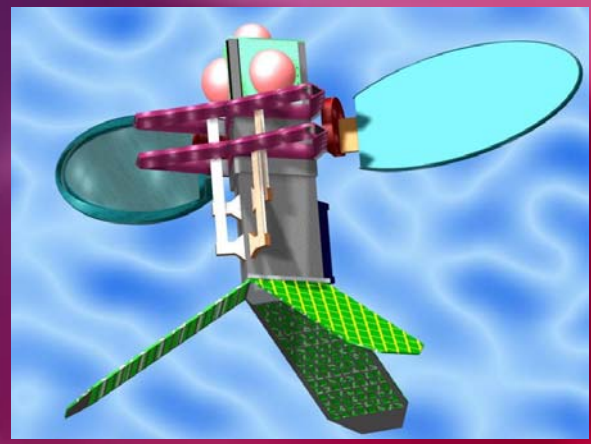




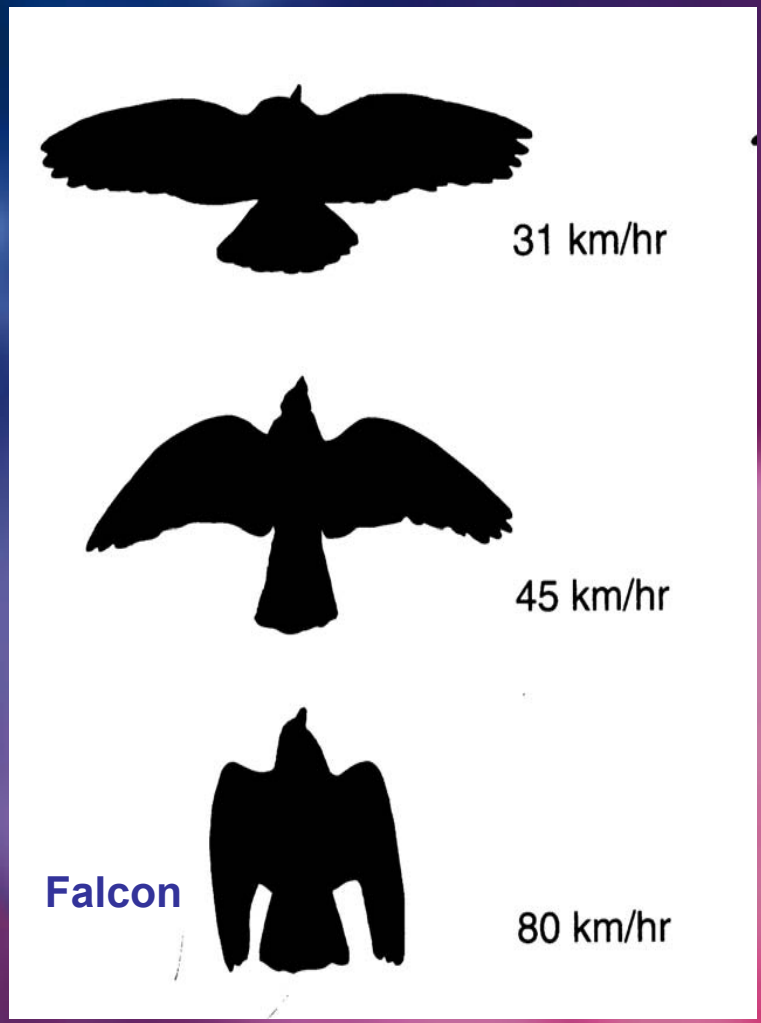


Biomimetic Flying Insects





Morphing Aircraft

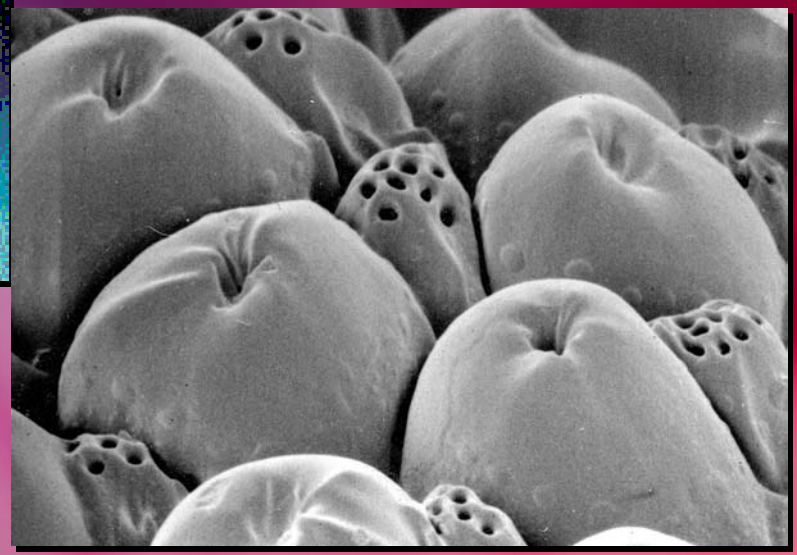


Transforming Fantasy

DARPA

Biomimetic IR Sensory Organs

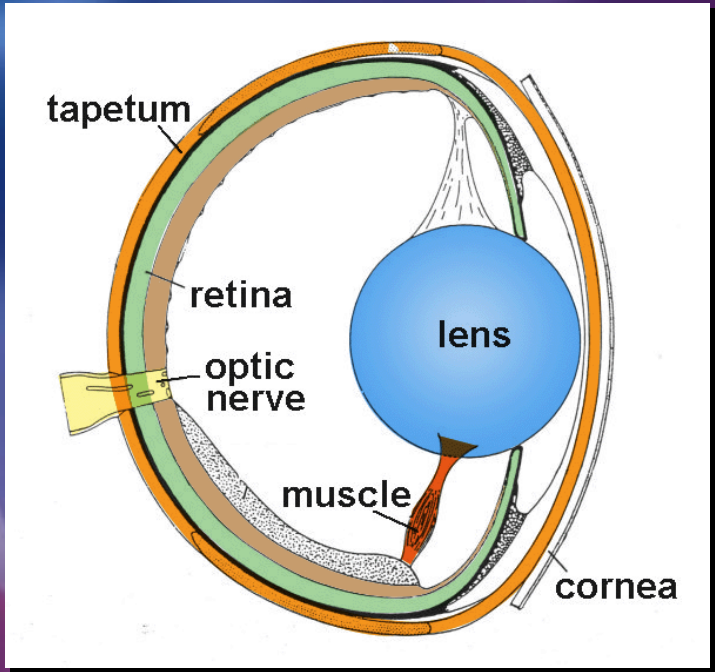
The Melanophila Beetle

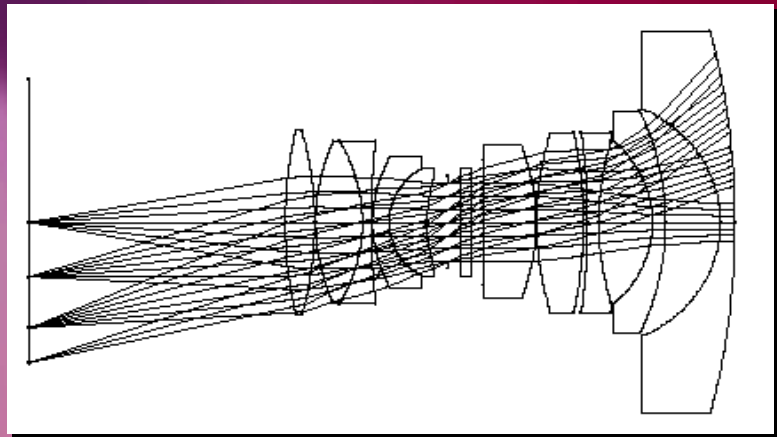


Infra-Red Organ

Fish Eye

Man-Made Multi-Lens System

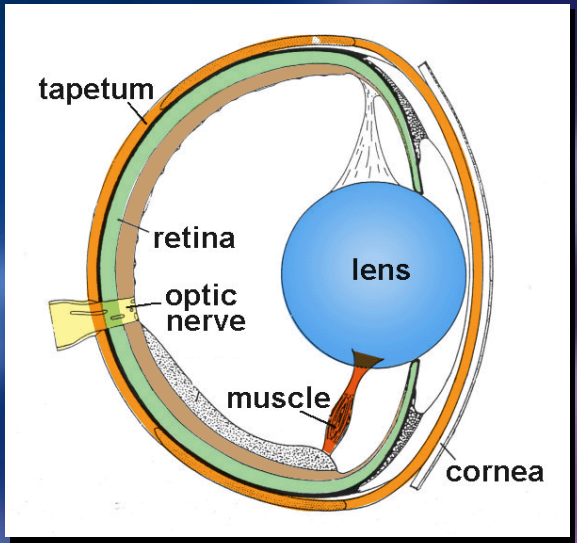


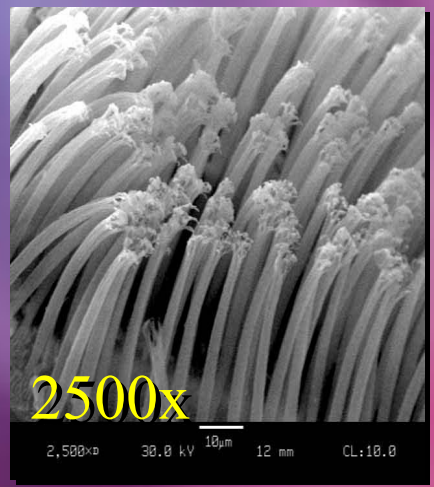


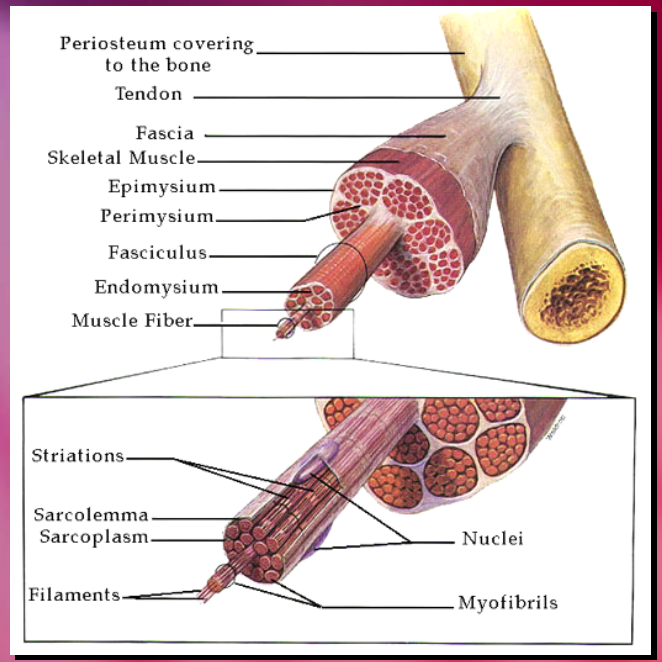
Multifunctional Materials

- Load-bearing structure
- Propulsion
- Survivability features
- Power (fuel)
- Payload

Challenge







Acknowledgments

- Alan Rudolph – Zoologist
- Leo Christodoulou – Material Science
- Len Buckley – Chemistry
- Ephrahim Garcia – Aeronautical Engineer
- Dennis Healy - Mathematics

Transformative Fantasy

DARPA


DARPA
DARPATech
2002 Symposium
Transforming
Fantasy